

**WE CLAIM:**

1. A selective hydrogenation process, comprising:  
preparing a reactant stream comprising an alkyne absorbed in a liquid absorbent;  
contacting the reactant stream with a selective hydrogenation catalyst in the presence of a gas stream comprising hydrogen at hydrogenation conditions to provide a product stream;  
separating the absorbent from the product stream to recover a product.
2. The process of claim 1 wherein the liquid absorbent is selected from the group consisting of NMP, acetone, THF, DMSO, MMA, and combinations thereof.
3. The process of claim 2 wherein the catalyst comprises a supported Group VIII metal.
4. The process of claim 3 wherein the catalyst further comprises a second metal selected from the group consisting of Group IB metals, Group IIB metals, Group IIIA metals, Group VIIB metals, and combinations thereof.
5. The process of claim 4 wherein the gas stream further comprises carbon monoxide.
6. The process of claim 5 wherein the second metal comprises a metal selected from the group consisting of Group IIB metals, Group IIIA metals, Group VIIB metals, and combinations thereof.
7. The process of claim 6 wherein the second metal comprises a metal selected from the group consisting of In, Ga, Mn, and Zn.
8. The process of claim 7 wherein the liquid absorbent comprises NMP.
9. The process of claim 8 wherein the second metal comprises Zn.
10. A selective hydrogenation process, comprising:

contacting an alkyne absorbed in a liquid absorbent with a catalyst in the presence of a hydrogen-containing stream at conditions conducive to selective hydrogenation to produce a product stream comprising a product alkene;

separating the liquid absorbent from the product stream to substantially recover the product alkene.

11. The process of claim 10 wherein the liquid absorbent is selected from the group consisting of NMP, acetone, THF, DMSO, MMA, and combinations thereof.

12. The process of claim 11 wherein the selective hydrogenation catalyst comprises a supported Group VIII metal.

13. The process of claim 12 wherein the selective hydrogenation catalyst further comprises a second metal selected from the group consisting of Group IIB metals, Group IIIA metals, Group VIIB metals, and combinations thereof.

14. The process of claim 13 wherein the second metal comprises a metal selected from the group consisting of In, Ga, Mn, and Zn.

15. The process of claim 14 wherein the liquid absorbent comprises NMP.

16. The process of claim 15 wherein the second metal comprises Zn.

17. A process for the selective hydrogenation of alkynes comprising:  
absorbing one or more alkynes in a liquid absorbent to provide a reactant stream;  
contacting said reactant stream with a catalyst in the presence of a hydrogen-containing gas stream at hydrogenation conditions to produce a product stream comprising the alkene analogs of the one or more alkynes;  
separating said alkene analogs from said product stream.

18. The process of claim 17 wherein the liquid absorbent is selected from the group consisting of NMP, acetone, THF, DMSO, MMA, and combinations thereof.

19. The process of claim 18 wherein the liquid absorbent is NMP.
20. The process of claim 19 wherein the hydrogen-containing gas stream further comprises carbon monoxide.
21. The process of claim 19 wherein the catalyst comprises a Group VIII metal and a catalyst support.
22. The process of claim 21 wherein the catalyst further comprises a second metal selected from the group consisting of Group IIB metals, Group IIIA metals, Group VIIB metals, and combinations thereof.
23. The process of claim 22 wherein the second metal is selected from the group consisting of In, Ga, Mn, and Zn.
24. The process of claim 23 wherein the catalyst support comprises a particulate alumina.
25. The process of claim 24 wherein the catalyst comprises Zn.
26. A process for the selective hydrogenation of acetylenic compounds, comprising:
  - absorbing one or more acetylenic compounds in a liquid polar non-hydrocarbon absorbent to provide a reactant stream;
  - contacting the reactant stream with a hydrogenation catalyst in the presence of a gas stream comprising hydrogen under selective hydrogenation conditions to provide a product stream, wherein said product stream comprises the ethylenic compounds corresponding to the one or more acetylenic compounds in the reactant stream;
  - separating the absorbent from the product stream.
27. The process of claim 26 wherein the liquid polar non-hydrocarbon absorbent comprises NMP.

28. The process of claim 27 wherein the gas stream further comprises carbon monoxide.
29. The process of claim 27 wherein the hydrogenation catalyst comprises a zinc-promoted palladium catalyst on an alumina support.
30. The process of claim 27 wherein the hydrogenation catalyst comprises a promoter selected from the group consisting of In, Ga, Mn, Zn, and combinations thereof.
31. The process of claim 30 wherein the selective hydrogenation conditions comprise a temperature of from 100°C to 150°C, a pressure of from 100 psig to 400 psig, a H<sub>2</sub>:CO of from 1:1 to 3:1, and a H<sub>2</sub>:C<sub>2</sub>H<sub>2</sub> of from 1:1 to 5:1.
32. The process of claim 31 wherein the promoter comprises Mn or Zn.
33. The process of claim 32 wherein the promoter comprises Zn.
34. A process for the selective hydrogenation of alkynes, comprising:  
preparing a liquid reactant stream comprising between 0.5 wt-% and 10 wt-% C<sub>2</sub>H<sub>2</sub> dissolved in n-methyl-2-pyrrolidone;  
contacting the reactant stream and a gas stream comprising a mixture of H<sub>2</sub> and CO in continuous flow with a catalyst at a feed ratio of H<sub>2</sub>:C<sub>2</sub>H<sub>2</sub> of from about 1:1 to about 5:1 at selective hydrogenation reaction conditions to produce a product stream,  
separating substantially all of the n-methyl-2-pyrrolidone from the product stream;  
recovering a product comprising C<sub>2</sub>H<sub>4</sub>.
35. The process of claim 34 wherein the catalyst comprises a supported Group VIII metal and a promoter selected from the group consisting of Group IIB metals, Group IIIA metals, and Group VIIB metals, and combinations thereof.
36. The process of claim 35 wherein the promoter is selected from the group consisting of In, Ga, Mn, Zn, and combinations thereof.

37. The process of claim 36 wherein the promoter is selected from the group consisting of In and Ga.
38. The process of claim 36 wherein the promoter is Mn.
39. The process of claim 36 wherein the promoter is Zn.
40. A process for the selective hydrogenation of alkynes, comprising:  
absorbing an alkyne compound in a liquid polar non-hydrocarbon absorbent to provide a reactant stream;  
contacting the reactant stream with a selective hydrogenation catalyst in the presence of a gas stream comprising hydrogen;  
hydrogenating at least a portion of the alkyne compound to provide a product stream comprising an alkene compound corresponding to the alkyne compound;  
substantially separating the absorbent from the product stream;  
recovering a product comprising the alkene compound.
41. The process of claim 40 wherein 90% or more of the alkyne compound is hydrogenated to the corresponding alkene compound.
42. process of claim 41, further comprising passing the product stream to one or more distillation columns, wherein said one or more distillation columns are operated such that 90% or more of the alkene compound is recovered as a gas from the top of the one or more distillation columns.
43. The process of claim 41, further comprising passing the product stream to one or more flash drums, wherein said one or more flash drums are operated such that 90% or more of the alkene compound is recovered as a gas from the top vents of the one or more flash drums.
44. The process of claim 41, further comprising passing the product stream to one or more distillation columns, wherein said one or more distillation columns are operated such that 90% or

more of the alkene compound is recovered as a liquid from the bottom of the one or more distillation columns.

45. The process of claim 41, further comprising passing the product stream to one or more flash drums, wherein said one or more flash drums are operated such that 90% or more of the alkene compound is recovered as a liquid from the bottom of the one or more flash drums.

46. The process of claim 41, further comprising mixing the product stream with a partitioning fluid wherein at least 90% of the alkene compound is evolved from the absorbent by exclusion.

47. The process of claim 41 wherein the liquid polar non-hydrocarbon absorbent is selected from the group consisting of NMP, DMF, acetone, THF, DMSO, MMA, and combinations thereof.

48. The process of claim 47 wherein the reactant stream is contacted with the selective hydrogenation catalyst in a reactor selected from the group consisting of slurry bubble column reactors, trickle bed reactors, three phase fluidized bed reactors, fixed bed reactors, riser reactors, fast-fluidized bed reactors, and combinations thereof.

49. The process of claim 47 wherein the reactant stream is contacted with the selective hydrogenation catalyst in a fixed bed reactor wherein the gas stream flows co-current to the reactant stream.

50. The process of claim 49 wherein the gas stream further comprises carbon monoxide.

51. The process of claim 50 wherein the reactor is operated at a temperature and pressure sufficient to maintain the absorbent in a liquid phase.

52. The process of claim 51 wherein the catalyst comprises a promoter selected from the group consisting of Group IIB metals, Group IIIA metals, and Group VIIB metals, and combinations thereof.

53. The process of claim 52 wherein the promoter is selected from the group consisting of In, Ga, Mn, Zn, and combinations thereof.
54. The process of claim 53 wherein the promoter is Zn.
55. The process of claim 53 wherein the promoter is Mn.
56. The process of claim 53 wherein the promoter is selected from the group consisting of In, Ga, and combinations thereof.